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# (54) Belt tensioning device for internal combustion engine

Treibriemenspannvorrichtung für Brennkraftmaschine

Dispositif tendeur de courroie pour moteur à combustion interne

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## Description

The present invention relates to a belt-driven automotive engine accessory drive system and means for tensioning such a system. Drive systems for the front end accessories of automotive engines typically include a belt having a tensioning device for maintaining the belt in contact with all the pulleys of the system, including the drive pulley, which is usually attached to the crankshaft of the engine, as well as with a plurality of driven pulleys, with at least one driven pulley attached to each rotating accessory. Such accessories frequently include an alternator, a power steering pump, an air conditioning compressor, a secondary air pump for emission controls, as well as other types of rotating devices.

Conventional tensioners utilise elastic force provided by, for example, a flat wire spring for maintaining a tensioning pulley in contact with the drive belt. Such a pulley is shown as item No. 34 in Figure 1 of the present application. Although damped tensioners have been used to some extent in automotive front end accessory drive systems, such tensioners typically are symmetrical in their damping characteristics. In other words, the motion of the tensioner is damped in the direction tending to increase the tension of the belt, as well as in the direction tending to decrease the tension in the belt. Unfortunately, if the tensioner is set up with a fairly low damping rate so as to allow the tensioner wheel to be compliantly in contact with the belt in a direction tending to tighten the belt, the tensioner will be allowed to pull back in a direction allowing the belt to loosen in the event that the following series of events occurs within the accessory drive system.

Figure 10 illustrates a problem with conventional tensioners which is solved by a tensioner according to the present invention. Operation of a front end accessory drive system with a corrective tensioner according to the present invention is shown in Figure 11. Both plots illustrate the rotational speed or angular velocity of an engine's alternator, idler pulley, and crankshaft pulley. The rotational speed of the idler pulley is a direct indicator of the speed of the drivebelt because it is assumed for the purpose of this discussion that minimal slip occurs between the idler pulley and the drivebelt; this is a good assumption because the rotating inertia of the idler pulley is relatively slight as compared with the rotational inertia of the other components of the engine's front end accessory drive system, particularly the alternator. As shown in both plots, crankshaft rpm decreases at a very high rate in the situation being considered. It has been determined that during wide open throttle transmission upshifts at lower gear speeds, such as the upshift from first to second gear with an automatic transmission and an engine speed of, for example 4500 rpm, the crankshaft may decelerate at a rate approaching 20,000 rpm per second. These high deceleration rates cause the front end accessory drivebelt to slip on one or more pulleys, particularly the crankshaft pulley, thereby giving an objectionable squealing noise which will be audible to the driver of the vehicle. The squealing noise produced by the loose drivebelt slipping on the crank pulley is caused by an overrunning effect of the alternator. Figures 10 and 11 show rotational speed data produced during tests in which an instrumented engine was rapidly decelerated from a high rate of speed. Figure 10 illustrates the behaviour of a prior art system; Figure 11 illustrates a system according to the present invention. As shown in Figure 10, alternator speed tails off to zero at about 300 msec. after the crankshaft stops. Similarly, the idler rpm and drivebelt speed tail off to zero at about 200 milliseconds following the stopping of the crankshaft. This occurs because once the crankshaft stops, the high rotational inertia of the alternator causes it to remain rotating and causes the alternator to pull the tensioner in a direction so as to loosen the belt. In turn, this causes a "bubble" of belt to extend from the alternator to the crankshaft pulley, and as a result the drivebelt slips on the crankshaft pulley. The resultant squeal may be very audible. In contrast with the operation according to the conventional tensioner at Figure 10, Figure 11 shows the results of the use of a tensioner and control system according to the present invention. In essence, the tensioner has a governor for controlling the rotational motion of the tensioner arm such that the tensioner's arm will be freely able to rotate in the direction in which the tension in the drivebelt is increased, while movement of the arm in the direction in which tension in the drivebelt is decreased, is resisted. Because the tensioner cannot move readily in the direction in which the tension in the drivebelt is decreased, the tension within the belt is maintained and, as a result, the deceleration rates of the drivebelt, the alternator and the crankshaft converge. This is shown graphically in Figure 11. Note that the three plots for alternator, idler and crankshaft all converge at a about 1100 msec. This means effectively that the alternator is no longer permitted to pull the tensioner in a direction tending to decrease the tension in the belt, and as a result, the alternator is decelerated in close congruence with the crankshaft's deceleration. This has the beneficial effect of preventing squeal of the drivebelt at the crank pulley, because with the tension maintained at a proper level in the drivebelt, the belt will not slip at the crankshaft pulley.

United States Patent 4,299,584 describes a belt tensioning device for an endless drive belt for a vehicle accessories drive system. A bracket is mounted on the engine adjacent the drive belt and a lever plate is pivotally mounted thereon. An idler pulley is rotatably mounted on the lever plate and is adapted to be moved in a belt tensioning direction for engagement with the drive belt. A coil spring is mounted on the bracket and is engaged with the lever plate and pulley in the belt tensioning direction. The device is provided with a spring steel detent which engages ratchet teeth to retard movement of the lever plate in a direction opposite to belt tensioning direction.

United States Patent 4,277,240 describes a hydraulic tensioning device for maintaining a predetermined amount of tensioning force on an endless drive belt for a vehicle accessories drive system. The drive belt rotates an idler pulley which hydraulically actuates a piston by driving the pump which supplies hydraulic fluid to the piston. The piston pivots a lever toward the belt whereupon the idler pulley engages the belt and exerts the desired tensioning force on the belt.

DE 4114716 is also concerned with a belt drive for an internal combustion engine in which the belt drives the generator and, for example, an air conditioning unit. The belt is tensioned by a tensioning pulley which is mounted on a pivoted lever which can be positioned by an electromagnetic actuator to vary the tension of the belt. Control leads run from the generator, the air conditioning unit and the battery to the actuator. When the air conditioning unit, for example, is switched on the pivoted lever is shifted by the actuator so that the belt tension is increased. The tensioning pulley is under the initial tension of a spring but the pivoted lever is acted on by the electromagnetic actuator which counteracts the force of the spring and relieves the tension acting on the belt drive. When the voltage of the battery falls or the air conditioning unit comes on, the voltage of the electromagnet is reduced so that the relieving force becomes less and the spring tensions the belt with greater force.

None of these documents show a tensioner having a governor which is controlled by an electric controller in response to an engine parameter indicative of a period of rapid engine deceleration.

According to the present invention, there is provided an accessory drive system for an automotive engine, comprising:

a drive pulley attached to an output shaft of the engine;

a flexible drive belt for connecting the drive pulley with a plurality of driven pulleys, with one driven pulley located upon each of a plurality of driven devices;

a tensioner for maintaining the drive belt in contact with each of said drive and driven pulleys, with said tensioner comprising an arm which is rotatably mounted to the engine and which has a wheel for contacting the drive belt, with the wheel being urged into contact with the drive belt by the arm, and with said tensioner further comprising a governor for controlling the rotational motion of the arm such that the arm will be freely able to rotate in the direction in which the tension in the drive belt is increased, with said governor resisting motion of the arm in the direction in which tension in the drive belt is decreased, wherein said governor comprises a hydraulic strut interposed between said tensioner arm and a mounting surface fixed to the engine adjacent the tensioner, such that linear motion of the strut accompanies rotational motion of the arm, with the strut having a connecting rod portion being able to move freely in the direction in which tension in the drive belt is increased, while resisting movement in the direction in which tension in the drive belt is decreased;

and an electric controller for operating the governor in response to at least one sensed engine parameter indicative of a period of rapid engine deceleration.

The hydraulic strut preferably comprises a piston reciprocably mounted within a cylinder mounted upon the connecting rod, with the connecting rod having a free end attached to the tensioner arm such that the piston slides within the cylinder as the tensioner arm rotates, with the motion of the piston being controlled by hydraulic fluid contained within the cylinder such that the motion of the piston in the direction which allows the tensioner to rotate in the direction in which the tension of the drivebelt is increased is substantially uninhibited, but motion of the piston in the direction in which the tensioner allows the tension within the drivebelt to decrease is restrained by hydrostatic force within the cylinder. Hydrostatic force is maintained within the cylinder by causing fluid leaving the cylinder under compressive force generated by the piston to flow through a restrictive orifice when the piston is moving in the direction in which tension within the drivebelt is decreased, with the strut having a parallel flow channel which is valved so as to allow fluid to flow freely from the cylinder when the piston is moving in the direction in which tension within the drivebelt is increased. The hydrostatic force within the cylinder may be maintained selectively by providing either an orifice and a bypass channel for the fluid to flow through when the piston is moving in the direction in which tension in the drivebelt is decreased, with flow through the bypass channel being controlled by a solenoid valve operated by an electronic controller such that when the solenoid valve is open, motion of the piston will be unrestrained in both directions. In general, an electronic controller may be used to operate the solenoid valve such that rotational motion of the arm is restricted during periods of operation characterised by either rapid engine deceleration or when engine speed exceeds a predetermined value, or both. As an alternative embodiment, a strut according to the present invention may comprise a slidable geared rack which is lockable in a plurality of linear positions by a solenoid actuated plunger engageable with the gear teeth of the rack, with the plunger and solenoid being operated by an electronic controller.

According to yet another aspect of the present invention, a method for controlling the tension of a flexible drivebelt in an accessory drive system of an automotive engine comprises the steps of sensing at least one engine operating parameter indicative of a period of rapid engine deceleration tending to decrease tension in the drivebelt below a threshold at which traction of the belt

is adequate to avoid slipping of the belt, and upon sensing a value of at least one operating parameter corresponding to a value of the drivebelt tension below the threshold, directing a tensioner associated with the accessory drive system to change from a mode in which the tensioner compliantly tensions the drivebelt to a mode in which the tensioner non-compliantly tensions the drivebelt so as to prevent the tension from decreasing. It is an advantage of the present invention that a system having a system according to the present invention will resist and prevent unwanted changes in drivebelt tension which occur or accompany rapid changes in engine speed.

The invention will now be described further, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a system illustration of a front end accessory drive system according to the present invention;
Figure 2 is a view of a hydraulic strut according to one aspect of the present invention;
Figure 3 is a side elevation of the strut illustrated in Figure 2;
Figure 4 is a section partially broken away of the strut according to Figure 2, taken along the line 4-4 of Figure 2;
Figure 5 is an illustration of another embodiment of the present invention in which a geared hub is lockable in a plurality of positions by an electronically controlled solenoid plunger;
Figure 6 is an illustration of a geared rack type of strut according to the present invention;
Figure 7 is an example of a friction brake strut according to another aspect of the present invention;
Figure 8 is a block diagram of a control system for a tensioner according to the present invention;
Figure 9 is an illustration of a strut according to the present invention having a solenoid operated control valve; and
Figures 10 and 11 illustrate the operation of a front end accessory drive without and with a system according to the present invention, respectively.

Figure 1 illustrates an automotive type internal combustion engine front end accessory drive system according to the present invention. Flexible drivebelt 12, which is driven by pulley 10 attached to the engine's crankshaft, powers a series of rotating accessories which may include an alternator, a power steering pump, an air conditioning compressor, a water pump, an air pump to operate an emission control system, and other rotating accessories known to those skilled in the art. Particularly included in the present combination of accessories is alternator 14 which, due to its high rotational inertia, would normally create a problem which is solved by a tensioner according to the present invention. Tensioner 18, as modified according to the present invention, maintains drivebelt 12 in contact with each of driven pulleys 16, as well as drive pulley 10, so that squealing or other objectionable noises will not occur. This is accomplished by maintaining proper tension in belt 12 at all times.

Figures 2, 3, and 4 illustrate an example of a hydraulic strut type of tensioner governor according to the present invention. As shown in Figures 2 and 3, strut 24 is attached to bracket 26 which is rigidly mounted to front surface 28 of the engine. Strut 24 is attached to bracket 26 by means of mounting pin 32. The strut has connecting rod 30 having a free end which is pivotally mounted to tensioner arm 20 at pivot point 21. Hydraulic strut 24 also has piston 36 mounted upon connecting rod 30. Piston 36 slides within cylinder 38 while following the rotational motion of arm 20. As seen from Figures 1 and 2, motion of arm 20 in the direction in which tension in drivebelt 12 is decreased is accompanied by upward motion toward the mounting end of strut 24 at point 32. Conversely, motion of the strut in the direction tending to increase the tension on drivebelt 12 is in a direction for piston 36 to move out of cylinder 38. Motion of connecting rod 30 and piston 36 in a direction in which tension in the drivebelt is increased, i.e., motion in which piston 36 is moving in the direction in which connecting rod 30 extends to a greater extent from cylinder 38, is substantially uninhibited because hydraulic oil within the cylinder is free to flow through low pressure passage 42, and after unseating check ball 44 from its seat, can freely flow to the upper side of cylinder 38 after having moved past check ball 44. Because check ball 44 is maintained on its seat by spring 48, which can be relatively light, movement of piston 36 and connecting rod 30 in a downward direction so as to accompany increasing tension in belt 12 is relatively uninhibited. If, on the other hand, the engine slows down precipitously so that alternator 14 would tend to pull arm 20 in the direction of decreased tension in belt 12, piston 36 would be forced in an upward direction, and the flow of hydraulic fluid from cylinder 38 would be through port 50 in the top of cylinder 38 and past metering screw 46 (Figure 4). High pressure passage 40, which allows fluid to flow from the cylinder and past metering screw 46 is substantially occluded by metering screw 46, or alternatively, by another type of orifice suggested by this disclosure. Accordingly, motion of piston 36 is essentially restricted by the hydrostatic force built up within cylinder 38. In essence, the motion of the piston may be hydrostatically locked, depending upon the degree of restriction imposed by metering screw 46. In this fashion, tensioner 24 will prevent tension on drivebelt 12 from being released due to the overrunning condition caused by alternator 14 or by any other overrunning accessory, for that matter, thereby preventing drivebelt 12 from slipping on any of the drive or driven pulleys.

Figure 6 shows a second embodiment of strut 24 according to the present invention, in which a slidable geared rack 62 is lockable in a plurality of linear posi-

tions by solenoid actuated plunger 64, which is engageable with geared teeth of rack 62, with the plunger and solenoid being operated by an electronic controller according to Figure 8. As shown in Figure 8, controller 94 receives a variety of information signals from a plurality of sensors 96, which may comprise speed sensors indicating the rotational speed of the engine or any other rotating component on the vehicle, or engine acceleration sensors, or other types of sensors known to those skilled in the art of engine control and suggested by this disclosure. In the event that controller 94 senses engine speed above a threshold, for example, or any other operating parameter indicative of engine operation in a mode tending to decrease tension in drivebelt 12 below a threshold at which traction of the belt is adequate to avoid slipping of the belt, controller 94 will direct tensioner 98 to change from a mode in which the tensioner compliantly tensions the drivebelt to a mode in which the tensioner non-compliantly tensions the drivebelt so as to prevent the tension from decreasing. In other words, controller 94 will issue a command to the strut as shown in Figure 6, for example, to lock solenoid 64 between two of the adjacent teeth on rack 62. As a result, pulley 34 will be maintained in contact with drivebelt 12 even if the engine decelerates precipitously, because arm 20 will be prevented from rotating in a direction so as to decrease the tension in the belt. As a result, drivebelt 12 will be prevented from slipping.

Figure 7 illustrates another embodiment of the present invention in which strut 24 comprises an electronically piloted sliding friction wedge plunger which operates as follows. In the event that controller 94 orders strut 24 to a locked position, solenoid 78 will be energised by controller 94, and plunger 76 will be pushed axially into engagement with one of brake shoes 74. Thereafter, brake shoes 74 will be partially engaged with the inside diameter of cylinder 38, and if the engine decelerates abruptly and arm 20 begins to push connecting rod 30 in a direction so as to reduce tension in the belt, wedge 72 will forcibly engage brake shoe 74 with the inside of cylinder 38 so as to lock tensioner 18 in an unyielding, non-compliant position, as previously discussed.

Figure 9 illustrates another embodiment of a hydraulic strut according to the present invention, in which the tensioner is allowed to normally be compliant in both directions. This is achieved by allowing fluid flow to accompany movement of piston 36 in both directions in a relatively unrestricted fashion in a normal condition. Thus, fluid is allowed to flow through bypass channel 54 even when the piston is moving in an upward direction, but only if solenoid 60 is maintaining pintle 58 in its fully retracted position, as illustrated in Figure 9. As shown in this figure, if controller 94 gives a signal to solenoid 60 to move pintle 58 onto seat 56, fluid flowing from cylinder 38, as the piston moves in the upward direction, will be caused to move through restrictive orifice 52, with the result that the hydrostatic lock condition previously described will be present and tensioner 18 will prevent belt 12 from moving to a condition of lesser tension. As before, solenoid 60 will be controlled so that motion of piston 36 will be restrained when the engine is operating in a mode of rapid engine acceleration or at higher engine speeds, or at other conditions known to those skilled in the art and suitable for application of the present invention.

Figure 5 illustrates yet another embodiment of the present invention in which plunger 88 is selectively engageable with teeth 86 on hub 84 of tensioner arm 20 such that rotation of the arm is selectively restricted upon command by controller 94, which may be arranged to respond to the operating conditions described in connection with the earlier embodiments.

## Claims

1. An accessory drive system for an automotive engine, comprising:

    a drive pulley (10) attached to an output shaft of the engine;
    a flexible drive belt (12) for connecting the drive pulley with a plurality of driven pulleys (16), with one driven pulley located upon each of a plurality of driven devices;
    a tensioner (18) for maintaining the drive belt (12) in contact with each of said drive (10) and driven pulleys (16), with said tensioner comprising an arm (20) which is rotatably mounted to the engine and which has a wheel (34) for contacting the drive belt (12), with the wheel (34) being urged into contact with the drive belt (12) by the arm (20), and with said tensioner further comprising a governor (24) for controlling the rotational motion of the arm (20) such that the arm (20) will be freely able to rotate in the direction in which the tension in the drive belt is increased, with said governor resisting motion of the arm in the direction in which tension in the drive belt (12) is decreased, wherein said governor (24) comprises a hydraulic strut (24) interposed between said tensioner arm (20) and a mounting surface fixed to the engine adjacent the tensioner (18), such that linear motion of the strut (24) accompanies rotational motion of the arm (20), with the strut (24) having a connecting rod portion (30) being able to move freely in the direction in which tension in the drive belt is increased, while resisting movement in the direction in which tension in the drive belt is decreased;
    and an electric controller (94) for operating the governor in response to at least one sensed engine parameter indicative of a period of rapid engine deceleration.

2. An accessory drive system according to Claim 1, wherein the hydraulic strut comprises a piston reciprocably mounted within a cylinder upon said connecting rod, with the connecting rod having a free end attached to the tensioner arm such that the piston slides within the cylinder as the tensioner arm rotates, with the motion of the piston being controlled by hydraulic fluid contained within the cylinder such that motion of the piston in the direction which allows the tensioner to rotate in the direction in which the tension in the drive belt is increased is substantially uninhibited, but motion of the piston in the direction in which the tensioner allows the tension within the drive belt to decrease is restrained by hydrostatic force within the cylinder.

3. An accessory drive system according to Claim 2, wherein hydrostatic force is maintained within the cylinder by causing fluid leaving the cylinder under a compressive force generated by the piston to flow through a restrictive orifice when the piston is moving in the direction in which tension within the drive belt is decreased, with the strut having a parallel flow channel which is valved so as to allow fluid to flow freely from the cylinder when the piston is moving in the direction in which tension within the drive belt is increased.

4. An accessory drive system according to Claim 1, wherein the hydraulic strut comprises a piston reciprocably mounted within a cylinder upon said connecting rod, with the connecting rod having a free end attached to the tensioner arm such that the piston slides within the cylinder as the tensioner arm rotates, with the motion of the piston being controlled by hydraulic fluid supplied to the cylinder such that motion of the piston in the direction so as to allow the tensioner to rotate in the direction in which the tension in the drive belt is increased is substantially uninhibited, but motion of the piston in the direction in which the tensioner allows the tension within the drive belt to decrease is selectively restrained by hydrostatic force within the cylinder.

5. An accessory drive system according to Claim 4, wherein hydrostatic force is selectively maintained within the cylinder by causing fluid leaving the cylinder under the compressive force of the piston to flow through either a restrictive orifice or a bypass channel when the piston is moving in the direction in which the tension within the drive belt is decreased, with flow through the bypass channel being controlled by a solenoid valve operated by said electronic controller such that when the solenoid valve is open, motion of the piston will be unrestrained in both directions.

6. An accessory drive system according to Claim 5, wherein said electronic controller operates said solenoid valve such that rotational motion of the arm is restricted during said period of rapid engine deceleration.

7. An accessory drive system according to Claim 5, wherein said electronic controller operates said solenoid valve such that rotational motion of the arm is restricted when engine speed exceeds a predetermined value.

8. An accessory drive system according to Claim 1, wherein said governor comprises an electronically lockable strut interposed between said tensioner arm and a mounting point adjacent the tensioner, such that linear motion of the strut accompanies rotational motion of the arm unless the strut is locked.

9. An accessory drive system according to Claim 8, wherein said strut comprises a slidable, geared rack which is lockable in a plurality of linear positions by a solenoid actuated plunger engageable with the gear teeth of said rack, with said plunger being operated by said electronic controller.

10. An accessory drive system according to Claim 9, wherein said electronic controller operates said plunger such that rotational motion of the arm is restricted during said period of rapid engine deceleration.

11. An accessory drive system according to Claim 9, wherein an electronic controller operates said plunger such that rotational motion of the arm is restricted when engine speed exceeds a predetermined value.

12. An accessory drive system according to Claim 1, wherein said governor comprises an electronically lockable plunger which is engageable with said tensioner arm such that rotational motion of the arm is selectively restricted.

13. An accessory drive system according to Claim 12, wherein said arm comprises a generally circular hub having a plurality of teeth disposed about the periphery thereof in proximity to said electronically lockable plunger.

14. An accessory drive system according to Claim 1, wherein said governor comprises an electronically piloted sliding friction wedge plunger located within a strut interposed between said tensioner arm and a mounting point adjacent the tensioner, such that linear motion of the strut accompanies rotational motion of the arm unless the strut is locked.

15. A method for controlling the tension of a flexible

drive belt in an accessory drive system for an automotive engine as claimed in any one of the preceding claims, comprising the steps of:

sensing at least one engine operating parameter indicative of a period of rapid engine deceleration tending to decrease tension in the drivebelt below a threshold at which traction of the belt is adequate to avoid slipping of the belt; and
upon sensing a value of said at least one operating parameter corresponding to a value of drive belt tension below said threshold, directing a tensioner associated with said accessory drive system to change from a mode in which the tensioner compliantly tensions the drive belt to a mode in which the tensioner noncompliantly tensions the drive belt so as to prevent the tension from decreasing.

## Patentansprüche

1. Ein Hilfsantriebssystem für einen Fahrzeugmotor bestehend aus:

einer Antriebsriemenscheibe (10), die an einer Abgabewelle des Motors befestigt ist;

einem flexiblen Antriebsriemen (12) zum Anschluss der Antriebsriemenscheibe mit einer Vielzahl von Antriebsriemenscheiben (16) mit einer Antriebsriemenscheibe, die sich auf jeder von einer Vielzahl von Antriebsvorrichtungen befindet;

einem Spanner (18), um den Antriebsriemen (12) in Kontakt mit jeder der besagten Antriebs- (10) und angetriebenen (16) Riemenscheiben zu halten, wobei der besagte Spanner einen Arm (20) enthält, der rotierbar am Motor montiert ist und der ein Rad (34) hat, um den Antriebsriemen (12) zu kontaktieren, wobei das Rad (34) durch den Arm (20) in Kontakt mit dem Antriebsriemen (12) gezwungen wird und wobei der besagte Spanner ausserdem einen Regler (24) enthält, um die Rotationsbewegung des Arms (20) zu steuern, so dass der Arm (20) frei ist, um in der Richtung zu rotieren in der die Spannung im Antriebsriemen erhöht wird, wobei der besagte Regler der Bewegung des Arms in der Richtung in der die Spannung im Antriebsriemen (12) reduziert wird, widersteht, in dem der besagt Regler (24) eine hydraulische Strebe (24) enthält, die sich zwischen dem besagten Spannerarm (20) und einer Montagefläche, die am Motor nahe des Spanners (18) befestigt ist, befindet, so dass eine lineare Bewegung der Strebe (24) die Rotationsbewegung des Arms (20) begleitet, wobei die Strebe (24) einen Pleuelabschnitt (30) hat, der sich frei in der Richtung bewegen kann, in der die Spannung im Antriebsriemen reduziert wird, während sie der Bewegung in der Richtung in der die Spannung im Antriebsriemen reduziert wird, widersteht;

und einem elektrischen Regelgerät (94) zum Betreiben des Reglers als Ansprechen auf mindestens einen erfassten Motorparameter, der die Dauer einer schnellen Geschwindigkeitsabnahme des Motors anzeigt.

2. Ein Hilfsantriebssystem nach Anspruch 1, in dem die hydraulische Strebe einen Kolben enthält, der wechselweise in einem Zylinder auf der besagten Pleuelstange montiert ist, wobei die Pleuelstange ein freies Ende hat, das am Spannerarm befestigt ist, so dass der Kolben im Zylinder gleitet, wenn der Spannerarm rotiert, wobei die Bewegung des Kolbens durch eine hydraulische Flüssigkeit gesteuert wird, die im Zylinder enthalten ist, so dass die Bewegung des Kolbens in der Richtung, die dem Spanner ermöglicht in der Richtung zu rotieren, in der die Spannung im Antriebsriemen erhöht wird, im wesentlichen unbegrenzt ist, aber die Bewegung des Kolbens in der Richtung, in der der Spanner ermöglicht, dass sich die Spannung im Antriebsriemen reduziert, durch die hydrostatische Kraft im Zylinder zurückgehalten wird.

3. Ein Hilfsantriebssystem nach Anspruch 2, in dem die hydrostatische Kraft im Zylinder beibehalten wird, indem verursacht wird, dass die Flüssigkeit aus dem Zylinder unter einer Durckkraft herausfliesst, die vom Kolben erzeugt wird, um durch eine Drosselöffnung zu fliessen, wenn sich der Kolben in der Richtung bewegt, in der die Spannung im Antriebsriemen reduziert wird, wobei die Strebe einen parallelen Strömungskanal hat, der mit einem Ventil versehen ist, so dass der Flüssigkeit ermöglicht wird, frei vom Zylinder zu fliessen, wenn sich der Kolben in der Richtung bewegt, in der die Spannung im Antriebsriemen reduziert wird.

4. Ein Hilfsantriebssystem nach Anspruch 1, in dem die hydraulische Strebe einen Kolben enthält, der wechselweise in einem Zylinder auf der besagten Pleuelstange montiert ist, wobei die Pleuelstange ein freies Ende hat, das am Spannerarm befestigt ist, so dass der Kolben im Zylinder gleitet, wenn der Spannerarm rotiert, wobei die Bewegung des Kolbens durch die hydraulische Flüssigkeit gesteuert wird, die zum Zylinder geleitet wird, so dass die Bewegung des Kolbens in der Richtung, die dem Spanner ermöglicht, in der Richtung zu rotieren, in

der die Spannung im Antriebsriemen erhöht wird, im wesentlichen unbegrenzt ist, aber die Bewegung des Kolbens in der Richtung in der der Spanner der Spannung im Antriebriemen ermöglicht sich zu reduzieren, wahlweise durch hydrostatische Kraft im Zylinder zurückgehalten wird.

5. Ein Hilfsantriebssystem nach Anspruch 4, in dem die hydrostatische Kraft wahlweise im Zylinder beibehalten wird, indem verursacht wird, dass die Flüssigkeit unter der Druckkraft des Kolbens aus dem Zylinder fliesst, um entweder durch eine Drosselöffnung oder einen Umgehungskanal (Bypaskanal) zu fliessen, wenn sich der Kolben in der Richtung bewegt, in der die Spannung im Antriebsriemen reduziert wird, wobei der Strom durch den Umgehungskanal durch ein Magnetventil gesteuert wird, das durch den besagten elektronischen Regler betätigt wird, so dass die Bewegung des Kolbens in beiden Richtungen uneingeschränkt sein wird, wenn das Magnetventil offen ist.

6. Ein Hilfsantriebssystem nach Anspruch 5, in dem der besagte elektronische Regler das besagte Magnetventil betätigt, so dass die Rotationsbewegung des Arms während der besagten Dauer der schnellen Geschwindigkeitsabnahme des Motors beschränkt wird.

7. Ein Hilfsantriebssystem nach Anspruch 5, in dem der besagte elektronische Regler das besagte Magnetventil betätigt, so dass die Rotationsbewegung des Arms beschränkt wird, wenn die Drehzahl des Motors einen vorbestimmten Wert übersteigt.

8. Ein Hilfsantriebssystem nach Anspruch 1, in dem der besagte Regler eine elektronisch blockierbare Strebe enthält, die sich zwischen dem besagten Spannerarm und einem Montagepunkt nahe des Spanners befindet, so dass die lineare Bewegung der Strebe die Rotationsbewegung des Arms begleitet, es sei denn die Strebe wäre blockiert.

9. Ein Hilfsantriebssystem nach Anspruch 8, in dem die besagte Strebe eine gleitbare Zahnstange enthält, die in einer Vielzahl von linearen Stellungen durch einen durch ein Magnet betätigten Kolben blockierbar ist, der mit den Zahnrädem der besagten Stange einrastet, wobei der besagte Kolben durch einen elektronischen Regler betätigt wird.

10. Ein Hilfsantriebssystem nach Anspruch 9, in dem der besagte elektronische Regler den besagten Kolben betätigt, so dass die Rotationsbewegung des Arms während der besagten Dauer der schnellen Geschwindigkeitsabnahme des Motors beschränkt wird.

11. Ein Hilfsantriebssystem nach Anspruch 9, in dem ein elektronischer Regler den besagten Kolben betätigt, so dass die Rotationsbewegung des Arms beschränkt wird, wenn die Drehzahl des Motors einen vorbestimmten Wert überschreitet.

12. Ein Hilfsantriebssystem nach Anspruch 1, in dem der besagte Regler einen elektronisch blockierbaren Kolben enthält, der mit dem besagten Spannerarm einrastet, so dass die Rotationsbewegung des Arms wahlweise beschränkt wird.

13. Ein Hilfsantriebssystem nach Anspruch 12, in dem der besagte Arm eine im allgemeinen kreisförmige Nabe mit einer Vielzahl von Zähnen enthält, die um deren Peripherie, in der Nähe des besagten elektronisch blockierbaren Kolbens angeordnet sind.

14. Ein Hilfsantriebssystem nach Anspruch 1, in dem der besagte Regler einen elektronisch gesteuerten gleitenden Reibungs-Hemmkolben enthält, der in einer Strebe angebracht ist, die sich zwischen dem besagten Spannerarm und einem Montagepunkt nahe des Spanners befindet, so dasss die lineare Bewegung der Strebe die Rotationsbewegung des Arms begleitet, es sei denn, die Strebe wäre blokkiert.

15. Eine Methode zur Steuerung der Spannung eines flexiblen Antriebsriemens in einem Hilfsantriebssystem für den Motor eines Fahrzeugs nach irgendeinem der vorausgegangenen Ansprüche, die die folgenden Stufen beinhaltet:

Erfassen mindestens eines Betriebsparameters des Motors, der eine Dauer der schnellen Geschwindigkeitsabnahme des Motors angibt, mit der Neigung, die Spannung im Antriebsriemen unter einer Schwelle zu reduzieren, an der sich der Zug des Riemens eignet, um des Gleiten des Riemens zu vermeiden und

nach Erfassen eines Wertes von mindestens einem besagten Betriebsparameter, der einem Wert der Spannung des Antriebsriemens unter der besagten Schwelle entspricht, das Lenken eines Spanners, der mit dem besagten Hilfsantriebssystem verbunden ist, um von einer Betriebsart, in der der Spanner den Antriebsriemen obligatorisch spannt, in eine Betriebsart zu wechseln, in der der Spanner den Antriebsriemen nicht obligatorisch spannt, um zu verhindern, dass die Spannung reduziert wird.

**Revendications**

1. Système d'entraînement d'accessoires destiné à un

moteur d'automobile, comprenant :

une poulie d'entraînement (10) fixée à un arbre de sortie du moteur,
une courroie de transmission souple (12) destinée à relier la poulie d'entraînement à une pluralité de poulies menées (16), une poulie menée étant située sur chacun d'une pluralité de dispositifs entraînés,
un tendeur de courroie (18) destiné à maintenir la courroie de transmission (12) en contact avec chacune desdites poulies d'entraînement (10) et menées (16), ledit tendeur de courroie comprenant un bras (20) qui est monté avec possibilité de rotation sur le moteur et qui comporte une roue (34) destinée à venir en contact avec la courroie de transmission (12), la roue (34) étant poussée jusqu'en contact avec la courroie de transmission (12) par le bras (20), et ledit tendeur de courroie comprenant en outre un régulateur (24) destiné à commander le mouvement de rotation du bras (20) de façon que le bras (20) puisse librement tourner dans le sens suivant lequel la tension de la courroie de transmission est augmentée, ledit régulateur s'opposant au mouvement du bras dans le sens suivant lequel la tension de la courroie de transmission (12) est diminuée, dans lequel ledit régulateur (24) comprend un vérin hydraulique (24) intercalé entre ledit bras (20) du tendeur de courroie et une surface de montage fixée au moteur à proximité du tendeur de courroie (18), de sorte qu'un mouvement linéaire du vérin (24) accompagne un mouvement de rotation du bras (20), le vérin (24) comportant une partie de bielle (30) qui peut se déplacer librement dans le sens suivant lequel la tension de la courroie de transmission est augmentée, tandis qu'elle s'oppose au déplacement dans le sens suivant lequel la tension de la courroie de transmission est diminuée,
et un contrôleur électrique (94) destiné à mettre en oeuvre le régulateur en réponse à au moins un paramètre du moteur détecté indicatif d'une période de décélération rapide du moteur.

2. Système d'entraînement d'accessoires selon la revendication 1, dans lequel le vérin hydraulique comprend un piston monté avec possibilité de va-et-vient à l'intérieur d'un cylindre sur ladite bielle, la bielle comportant une extrémité libre fixée au bras du tendeur de courroie de sorte que le piston coulisse à l'intérieur du cylindre lorsque le bras du tendeur de courroie tourne, le mouvement du piston étant commandé par du fluide hydraulique contenu à l'intérieur du cylindre, de sorte que le mouvement du piston dans le sens qui permet au tendeur de courroie de tourner dans le sens suivant lequel la tension de la courroie de transmission est augmentée, est pratiquement illimité, mais le mouvement du piston dans le sens dans lequel le tendeur de courroie permet à la tension de la courroie de transmission de diminuer, est limité par la force hydrostatique à l'intérieur du cylindre.

3. Système d'entraînement d'accessoires selon la revendication 2, dans lequel une force hydrostatique est maintenue à l'intérieur du cylindre en amenant le fluide quittant le cylindre sous l'effet d'une force de compression générée par le piston, à s'écouler au travers d'un orifice calibré lorsque le piston se déplace dans le sens dans lequel la tension de la courroie de transmission est diminuée, le vérin comportant un canal d'écoulement parallèle qui est commandé par clapet de manière à permettre au fluide de s'écouler librement hors du cylindre lorsque le piston se déplace dans le sens dans lequel la tension de la courroie de transmission est augmentée.

4. Système d'entraînement d'accessoires selon la revendication 1, dans lequel le vérin hydraulique comprend un piston monté avec possibilité de va-et-vient à l'intérieur d'un cylindre sur ladite bielle, la bielle comportant une extrémité libre fixée au bras du tendeur de courroie de sorte que le piston coulisse à l'intérieur du cylindre lorsque le bras du tendeur de courroie tourne, le mouvement du piston étant commandé par du fluide hydraulique introduit dans le cylindre, de sorte que le mouvement du piston dans le sens qui permet au tendeur de courroie de tourner dans le sens suivant lequel la tension de la courroie de transmission est augmentée, est pratiquement illimité, mais le mouvement du piston dans le sens dans lequel le tendeur de courroie permet à la tension de la courroie de transmission de diminuer, est limité de façon sélective par la force hydrostatique à l'intérieur du cylindre.

5. Système d'entraînement d'accessoires selon la revendication 4, dans lequel une force hydrostatique est maintenue sélectivement à l'intérieur du cylindre en amenant le fluide quittant le cylindre sous l'effet de la force de compression du piston à s'écouler par l'intermédiaire soit d'un orifice calibré, soit d'un canal de dérivation lorsque le piston se déplace dans le sens dans lequel la tension de la courroie de transmission est diminuée, l'écoulement par l'intermédiaire du canal de dérivation étant commandé par une électrovanne mise en oeuvre par ledit contrôleur électronique de façon que, lorsque l'électrovanne est ouverte, le mouvement du piston soit libre dans les deux sens.

6. Système d'entraînement d'accessoires selon la revendication 5, dans lequel ledit contrôleur électro-

nique actionne ladite électrovanne de façon que le mouvement de rotation du bras soit limité pendant ladite période de décélération rapide du moteur.

7. Système d'entraînement d'accessoires selon la revendication 5, dans lequel ledit contrôleur électronique actionne ladite électrovanne de façon que le mouvement de rotation du bras soit limité lorsque le régime du moteur dépasse une valeur prédéterminée.

8. Système d'entraînement d'accessoires selon la revendication 1, dans lequel ledit régulateur comprend un vérin verrouillable électroniquement intercalé entre ledit bras du tendeur de courroie et un point de montage adjacent au tendeur de courroie, de sorte qu'un mouvement linéaire du vérin accompagne le mouvement de rotation du bras, sauf si le vérin est verrouillé.

9. Système d'entraînement d'accessoires selon la revendication 8, dans lequel ledit vérin comprend une crémaillère coulissante, qui peut être verrouillée dans une pluralité de positions linéaires par un plongeur actionné par électro-aimant, pouvant se mettre en prise avec les dents d'engrenage de ladite crémaillère, ledit plongeur étant mis en oeuvre par ledit contrôleur électronique.

10. Système d'entraînement d'accessoires selon la revendication 9, dans lequel ledit contrôleur électronique met en oeuvre ledit plongeur de façon que le mouvement de rotation du bras soit limité pendant ladite période de décélération rapide du moteur.

11. Système d'entraînement d'accessoires selon la revendication 9, dans lequel un contrôleur électronique met en oeuvre ledit plongeur de façon que le mouvement de rotation du bras soit limité lorsque le régime du moteur dépasse une valeur prédéterminée.

12. Système d'entraînement d'accessoires selon la revendication 1, dans lequel ledit régulateur comprend un plongeur verrouillable électroniquement qui peut être mis en prise avec ledit bras du tendeur de courroie de façon que le mouvement de rotation du bras soit limité sélectivement.

13. Système d'entraînement d'accessoires selon la revendication 12, dans lequel ledit bras comprend un moyeu généralement circulaire comportant une pluralité de dents disposées autour de la périphérie de celui-ci à proximité dudit plongeur verrouillable électroniquement.

14. Système d'entraînement d'accessoires selon la revendication 1, dans lequel ledit régulateur comprend un plongeur à coin de friction coulissant piloté électroniquement, situé à l'intérieur d'un vérin intercalé entre ledit bras du tendeur de courroie et un point de montage adjacent au tendeur de courroie, de sorte que le mouvement linéaire du vérin accompagne un mouvement de rotation du bras, sauf si le vérin est verrouillé.

15. Procédé de commande de la tension d'une courroie d'entraînement souple dans un système d'entraînement d'accessoires destiné à un moteur d'automobile, selon l'une quelconque des revendications précédentes, comprenant les étapes consistant à :

détecter au moins un paramètre de fonctionnement du moteur indicatif d'une période de décélération rapide du moteur tendant à diminuer la tension de la courroie de transmission au-dessous d'un seuil au niveau duquel la traction sur la courroie est adéquate pour éviter un patinage de la courroie, et
lors de la détection d'une valeur dudit au moins un paramètre de fonctionnement correspondant à une valeur de tension de la courroie de transmission au-dessous dudit seuil, orienter un tendeur de courroie associé audit système d'entraînement d'accessoires de façon à passer d'un mode dans lequel le tendeur de courroie tend la courroie de transmission avec élasticité à un mode dans lequel le tendeur de courroie tend la courroie de transmission sans élasticité, de manière à empêcher la tension de diminuer.

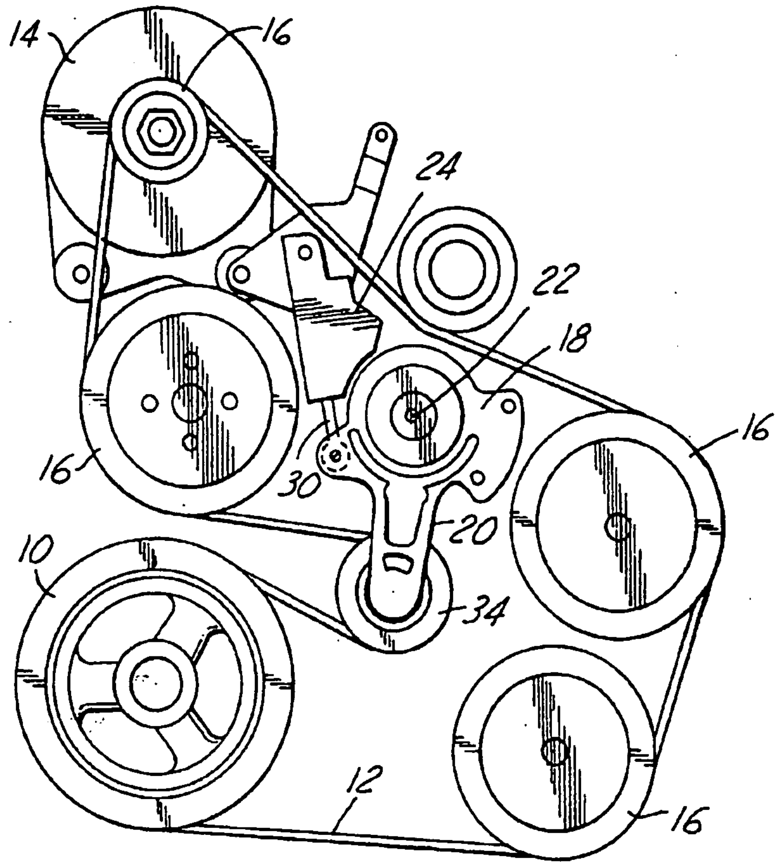


FIG. 1

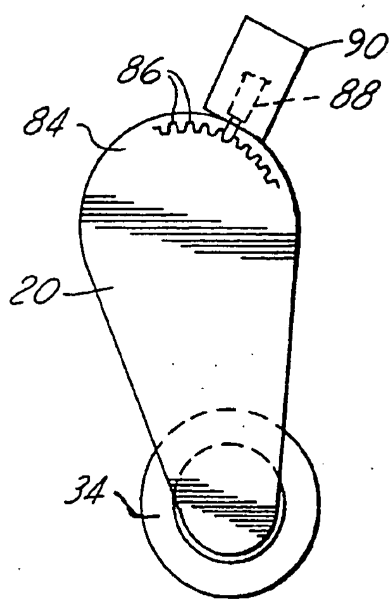


FIG. 5

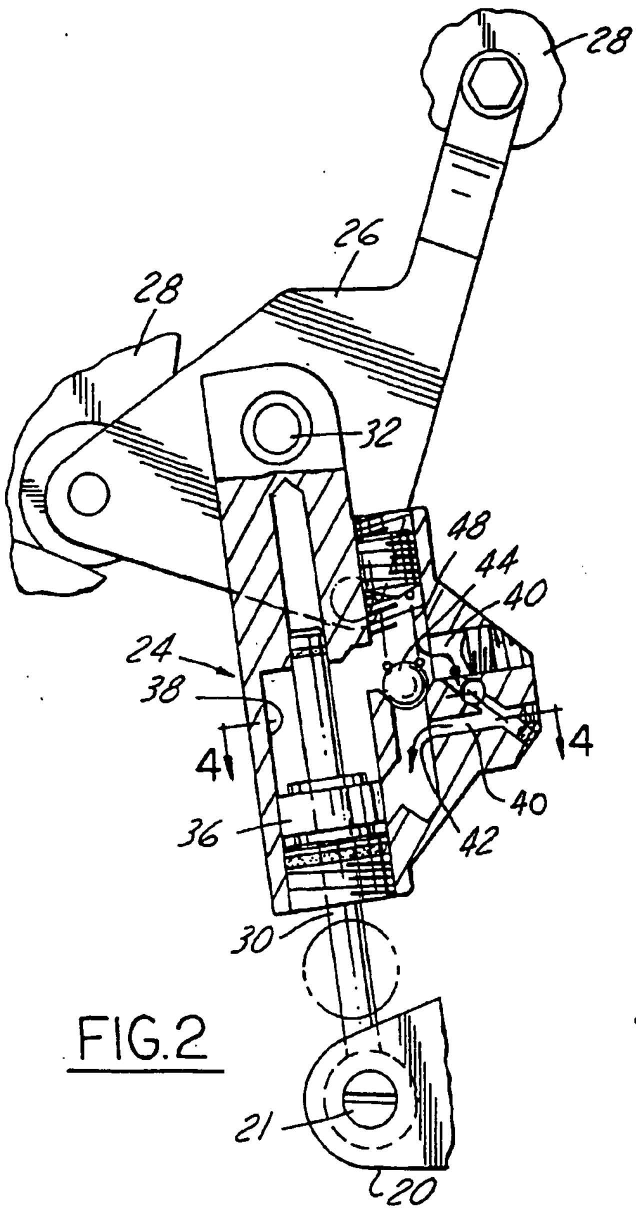


FIG.2

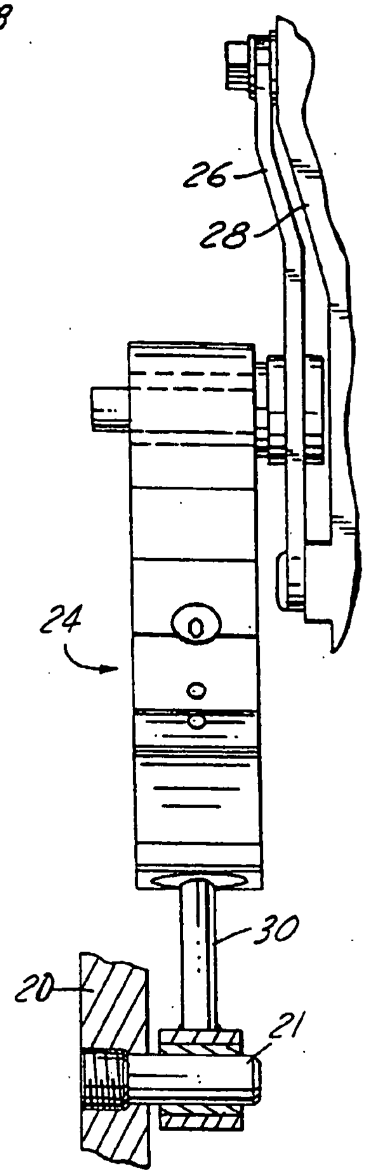


FIG.3

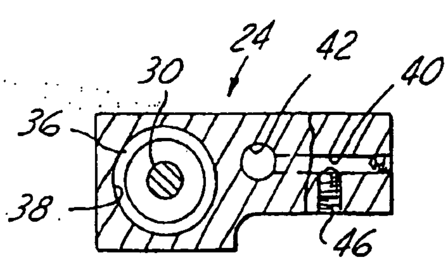


FIG.4

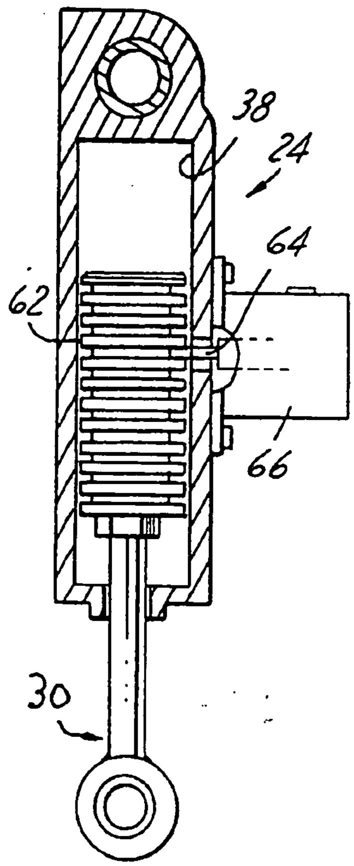


FIG.6

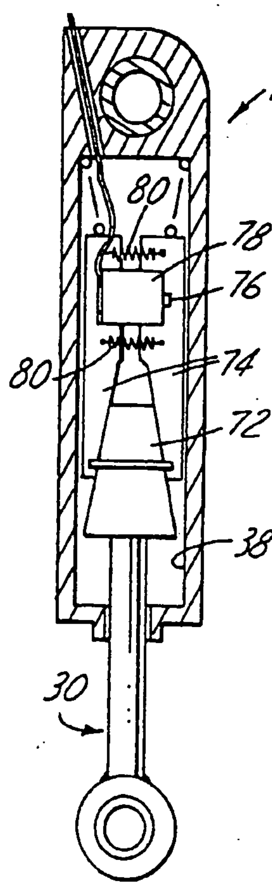


FIG.7

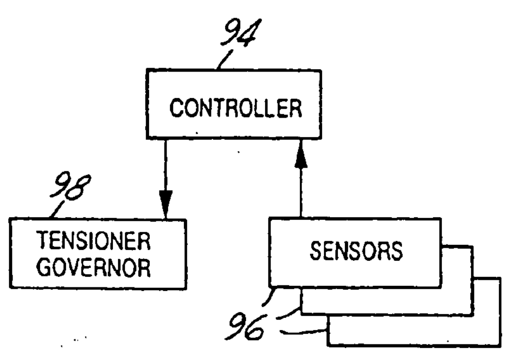


FIG.8

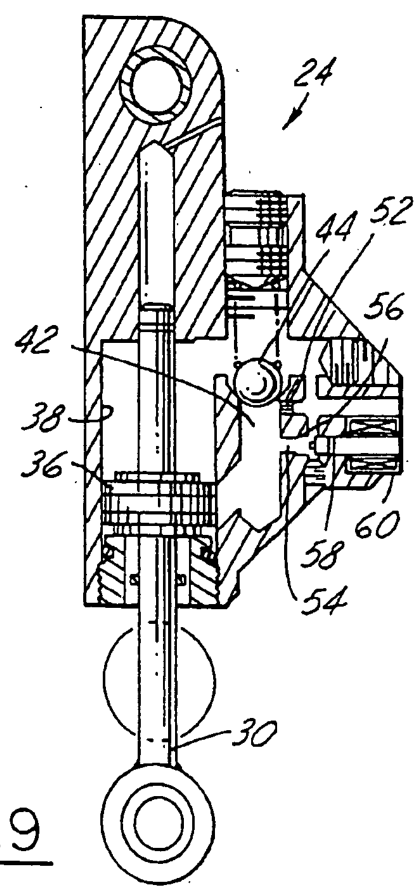


FIG.9

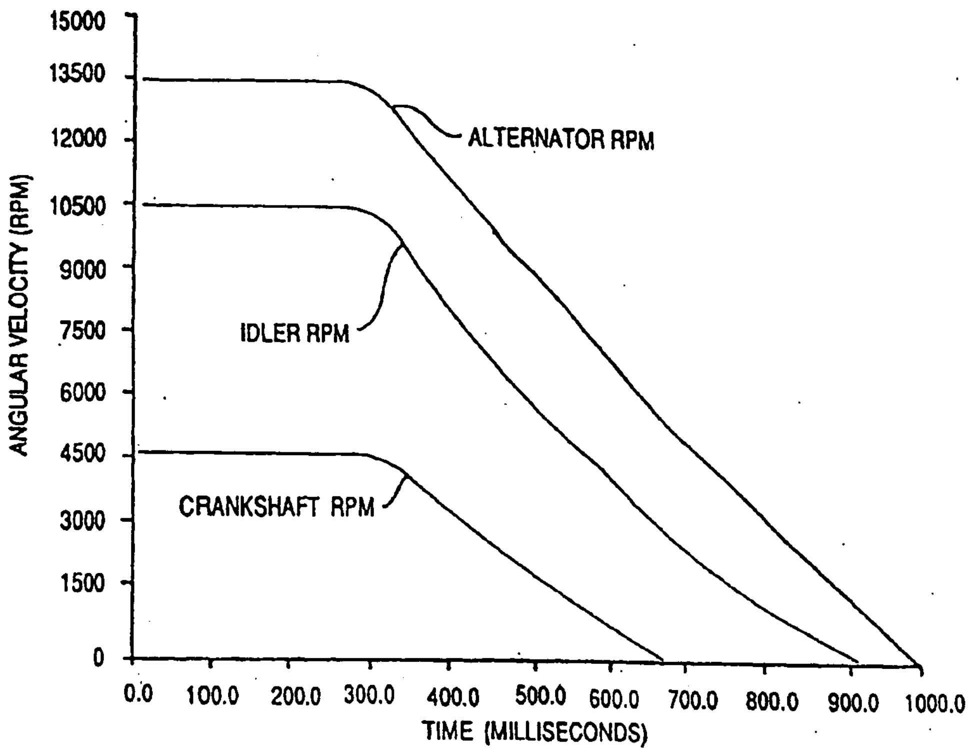
15000
13500
12000
10500
9000
7500
6000
4500
3000
1500
0
ANGULAR VELOCITY (RPM)
ALTERNATOR RPM
IDLER RPM
CRANKSHAFT RPM
0.0
100.0
200.0
300.0
400.0
500.0
600.0
700.0
800.0
900.0
1000.0
TIME (MILLISECONDS)

FIG.10

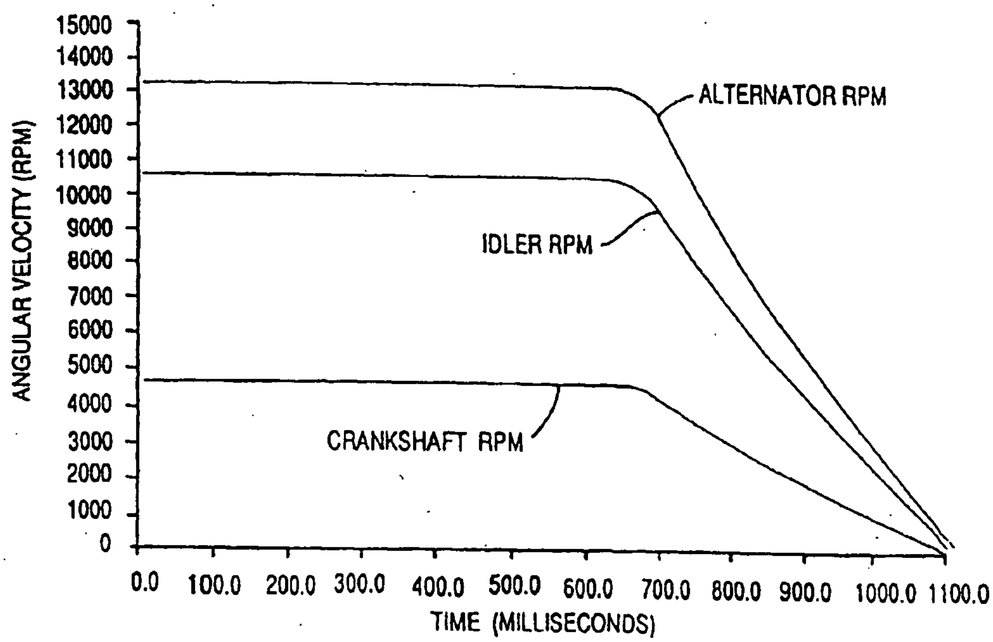
15000
14000
13000
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
ANGULAR VELOCITY (RPM)
ALTERNATOR RPM
IDLER RPM
CRANKSHAFT RPM
0.0
100.0
200.0
300.0
400.0
500.0
600.0
700.0
800.0
900.0
1000.0
1100.0
TIME (MILLISECONDS)

FIG.11